Culverts

Culverts may be either temporary or permanent installations. Temporary culverts are those that are installed and used for less than 30 consecutive months. Culvert sizing will increase if the culvert is considered a permanent installation. Permanent installations are those remaining following logging at the request of the timber buyer or landowner (proper permitting may be required). The purpose and duration of time for a culvert's use are determining factors in selection of culvert diameter. If circumstances dictate that a culvert sized with the intention of being temporary will in fact remain as a permanent structure, the culvert should be replaced with a culvert sized to permanent specifications. Since culvert replacement and size upgrade is expensive, it is important that the logger and landowner are clear on the long-term use of forest roads, stream crossings and culverts.

Most culvert installations for harvesting purposes are considered temporary and must be removed. A reduced-sized culvert is permitted for temporary culverts.

Temporary Culvert Chart

The following table lists culvert diameters for temporary culvert sizes. *This table is intended to be used as a guide. No guarantees are given or implied by the use of this table. The Virginia Department of Forestry retains no liability for the failure of pipes.*

Table 6
Temporary Culvert Sizing (2-Year Event)

Culvert Size (inches)	Watershed (in acres)		
	Coastal	Piedmont	Mountains
15	Up to 65	Up to 35	Up to 15
18	65-90	35-65	15-25
24	90-200	65-110	25-40
30	200-400	110-210	40-60
36	400-700	210-420	60-135
42	-	-	135-230

- Drainage basins larger than 5 square miles require a permit from the Virginia Marine Resources Commission
- Based on N.R.C.S. TR-55 Method, modified for a 2-year frequency storm event
- Assumes B soils; a CN = 55; and sheet and shallow concentrated flows only for averages of 4 watersheds for each physiographic region of the state.
- Coastal Plain: Areas East of Interstate 95
- Piedmont: Area East of Route 29 and West of Interstate 95
- Mountains: Area West of Route 29
- Calculations for specific situations will provide a more accurate culvert size.
- Culvert crossing solutions for watersheds greater than 600 acres should be designed based on the specific situation, or other options considered.

Permanent Culvert Chart

The following table lists culvert diameters for permanent culvert sizes. *This table is intended to be used as a guide. No guarantees are given or implied by the use of this table. The Virginia Department of Forestry retains no liability for the failure of pipes.*

Table 7
Permanent Culvert Sizing Chart (10-Year Event)

Culvert Size (inches)	Watershed (acres)		
	Coastal	Piedmont	Mountains
15	Up to 8	Up to 7	Up to 4
18	8-12	7-10	4-7
24	12-25	10-20	7-12
30	25-35	20-30	12-15
36	35-70	30-50	15-25
42	70-100	50-75	25-35
48	100-150	75-110	35-55
54	150-240	110-170	55-75
60	240-360	170-240	75-100
66	360-550	240-350	100-135
72	-	-	135-200

- Drainage basins larger than 5 square miles require a permit from the Virginia Marine Resources Commission
- Based on N.R.C.S. TR-55 Method, modified for a 2-year frequency storm event
- Assumes B soils; a CN = 55; and sheet and shallow concentrated flows only for averages of 4 watersheds for each physiographic region of the state.
- Coastal Plain: Areas East of Interstate 95
- Piedmont: Area East of Route 29 and West of Interstate 95
- Mountains: Area West of Route 29
- Calculations for specific situations will provide a more accurate culvert size.
- Culvert crossing solutions for watersheds greater than 600 acres should be designed based on the specific situation, or other options considered.

If it is preferable to place either two or three smaller culverts instead of one larger one, Table 8 shows the required diameters. For example, the 66-inch permanent culvert could be replaced with three 42-inch culverts installed side by side.

Table 8
Culvert Alternatives (Diameter in Inches)

Required Culvert Diameter	2 Culvert Alternative	3 Culvert Alternative
15	-	-
18	15, 15	-
24	15, 18	15, 15, 15
30	18, 24	18, 18, 18
36	24, 30	18, 24, 24
42	30, 30	24, 24, 30
48	36, 36	30, 30, 30
54	36, 42	30, 36, 36
60	42, 48	36, 36, 42
66	42, 54	42, 42, 42
72	48, 60	48, 48, 48
84	60, 66	48, 54, 54

Culvert Installation Specifications

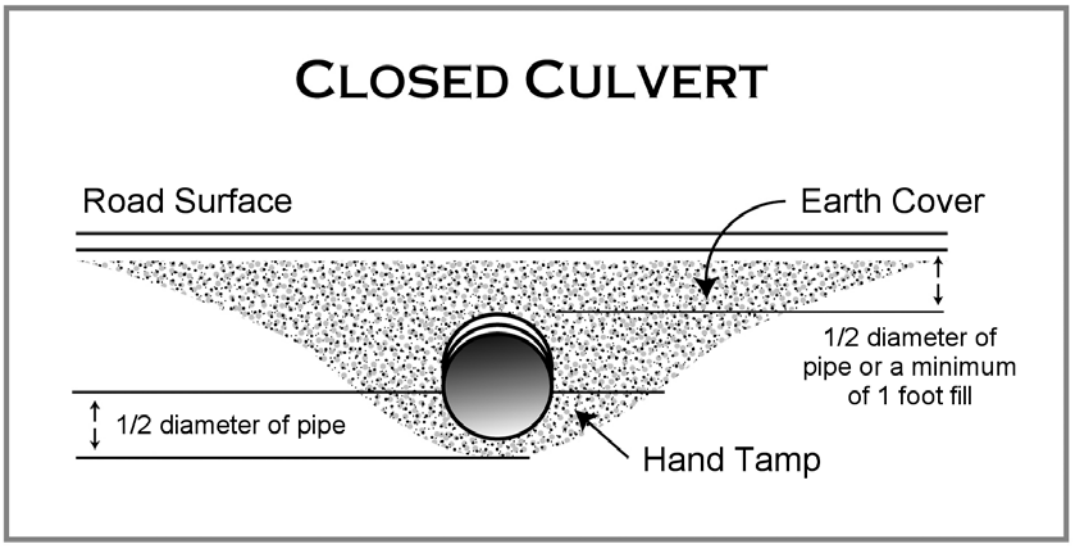
1. The pipe length will extend 1 foot beyond the edge of the fill material on each side of the culvert.

2. The culvert should be placed on the same grade as the natural stream bottom.

3. Crossings should be installed at as close to right angles to the stream as possible. Erosion protection measures will need to be used to minimize soil movement. Rip-rap, filter cloth, seeding and mulching, and non-erodible surfaces may be necessary in any culvert installation. This is important at both the inlet and outlet end of the pipe where scour can occur.

4. Culverts should be installed with 10% of its diameter below the streambed. This will minimize undercutting at the inlet or outlet. If the outlet is more than 6 inches above the natural stream channel, a non-erodible energy absorbing structure should be placed at the outlet.

5. Culverts require periodic maintenance and inspection to avoid plugging with leaves and debris.



6. If a culvert is to be installed in soft or sandy material, use of small crushed stone as a stable base under the pipe will cause minimal settling of the pipe. When the logging is completed and a temporary pipe will be removed, remove all material used during construction and any debris generated following construction from the stream channel and re-establish its natural dimension and profile. Earth cover over pipes should be half the culvert diameter but not less than 1 foot.

7. Culvert pipes less than 15 inches in diameter are not recommended for stream crossings.

Fords

Natural rock fords are an acceptable crossing method in portions of the Piedmont and Mountains areas. They may have some limited use in portions of the Coastal Plain as well. *In some cases, they may be the most acceptable of the stream crossing types because of the reduced amount of continued stream disturbance.* When fords are used, streambeds should have a firm rock base.

Any changes made to stream bottoms–including the addition of foreign material or unnatural material into a stream that has a drainage area in excess of 5 square miles–requires a permit from the Virginia Marine Resources Commission. Any changes made to improve an existing ford or create a new ford on streams with less than a 5 square-mile drainage area will have to adhere to forestry BMPs.

In some cases, the temporary use of wooden mats in a stream channel may be allowable to increase the carrying capacity of the ford. These mats must be removed following use. The addition of crushed limestone rock might be allowable in certain situations to level the stream bottom for truck traffic. Care should be taken to minimize the addition of stone for this purpose so as not to restrict the natural flow of the stream. Geo Web® material may be allowed to create a "hardened" stream bottom in certain situations. (See Geo Web® design specifications in Appendix A.) Use of the ford should be temporary and be restricted to low-traffic volumes. The water depth should be no more than an average 2 feet deep for that section of stream being crossed. Crossing should be made at right angles to the stream. Locate fords where stream banks are low and with stable approaches. To avoid sediment delivery to the stream, stabilize approaches with rock a minimum of 50 feet from the water's edge on both sides of the stream and maintain a clean layer of rock at all times.

Equipment crossing the stream should have no leaks of hydraulic oil, engine oil, fuel or any other foreign substance.

Rock approaches should be underlined with geotextile fabric where necessary.

Installation of a Geo-Web® hardened ford

Guidelines for Skid Trails

A skid trail by definition is an unsurfaced travelway, usually a single lane trail or narrow road typically narrower and sometimes steeper than a haul road. Skid trails are generally temporary pathways over forest soils where logs, trees or roundwood products are dragged, resulting in ground disturbance.

The skid trail is used to move logs, tree lengths, or roundwood products from the stump to the log landing.

Specifications

Locate log landings first and lay out road approach with grades less than 15%. Major skid trails should have planned locations to minimize damage to the residual stand, reduce erosion and sedimentation, and provide the most economical method for skidding products. Planning is needed for efficient skid trail operation in the woods.

1. Bladed or dozed skid trail grades should not exceed 25%. However, steeper segments may be required to avoid boundary lines, sensitive areas, or other areas not accessible using skid trails of lesser grades. Allowances for skid trail grades of up to 35% for short segments can be acceptable. If steeper grades are necessary, practices must be used to prevent concentrated water flow that causes gullying. Skid trails should not be constructed on sideslopes exceeding 60%. If it is impossible to limit exposure of mineral soil, alternate systems such as extra cable length or cable yarding should be considered.

2. Overland and dispersed skidding on steep slopes should not exceed 35% or when bare soil areas provide potential for channelized flow.

3. Skid trails should be located outside the SMZ.

4. Any skid trails that must cross a perennial stream, intermittent stream, or drainage ditch should use a bridge or culvert of acceptable design (see Stream Crossing section).

   Logs shall not be dragged through an intermittent or perennial stream.

   Approaches to stream crossings should be as close to right angles to the stream direction as possible.

5. Install water turnouts 25 feet prior to a stream crossing to direct surface runoff into undisturbed areas of the SMZ.

6. A brush mat of logging slash can be used to stabilize skid trails on stream crossing approaches. This alleviates rutting and firms up the running surface.

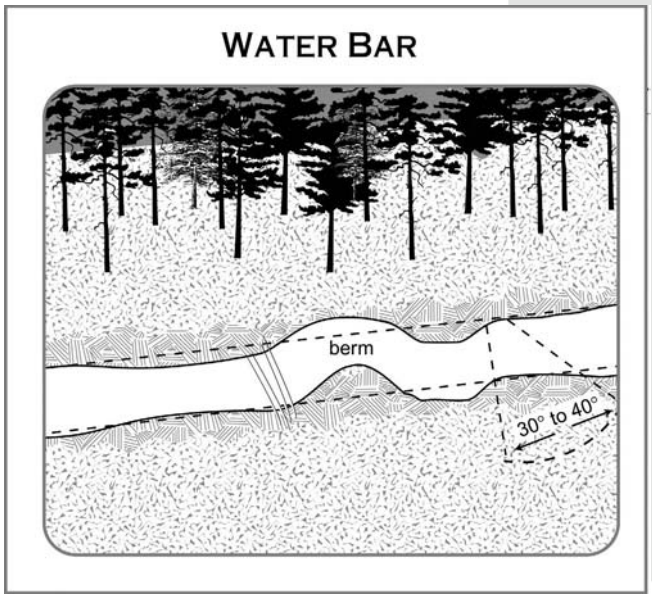
7. Climb upslope on a slant or zigzag pattern to avoid long continuous grades.

8. Skidding should be restrained when soils are saturated to prevent excessive soil compaction and channelized erosion. The skimming of saturated soils from skid trails should be avoided.

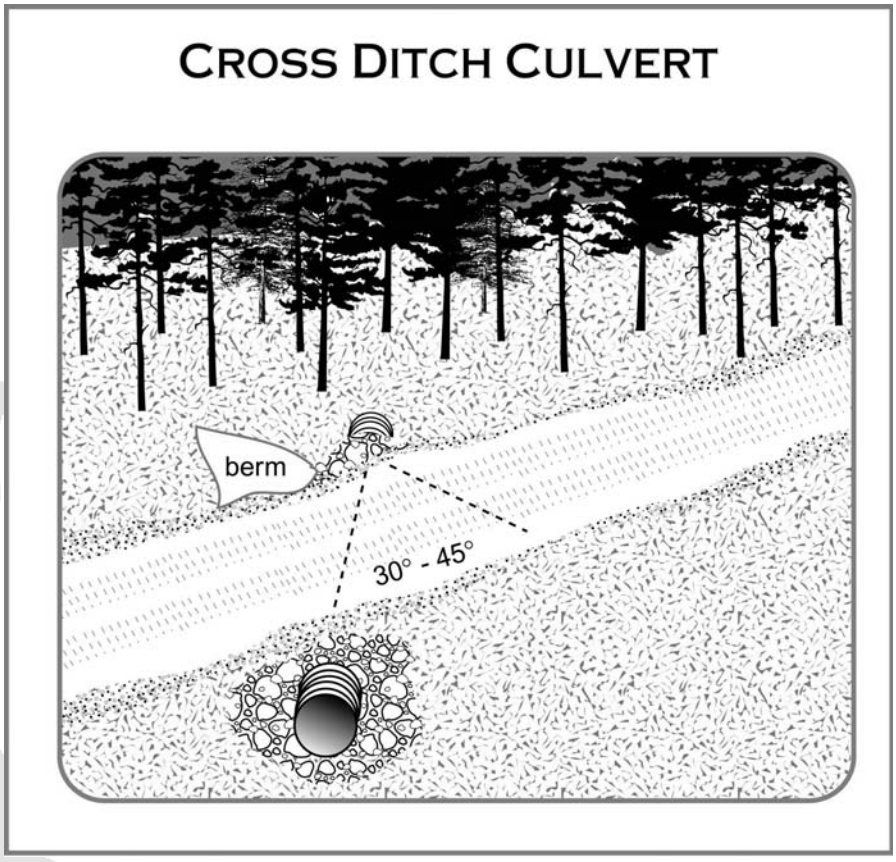
9. Rutting should be avoided whenever possible and especially where it causes channelized erosion. If rutting is unavoidable, concentrated skidding may be used to reduce the amount of disturbance but in no instance may channelized erosion be allowed to direct sediment into a stream channel. Site preparation should be used to ameliorate excessively compacted or rutted sites.

10. Upon completion of skidding, water bars should be installed immediately in the areas subject to erosion. The primary need is drainage of surface water from the skid road and exposed soils by establishing water bars at the recommended intervals (page 143).

11. Water bars should be installed at a 30-45° angle downslope, with ends open to prevent water accumulation behind them. A permanent vegetative cover should be established upon exposed roads, trails and soils that are greater than or equal to 5% slope when subject to erosion (see Appendix D). Scattered logging slash or other ground cover on the trails or exposed soils may enhance soil stability but should not be substituted for appropriate water bars and seeding.



12. Water turnouts should be installed on main skid roads. Cross drainage should be installed immediately above extra steep pitches in skid roads and below bank seepage spots.



13. Identify bumper trees and/or install fender logs on the outside edge of skid roads on steep slopes and at turns and switchbacks to prevent logs from rolling off the skid road and to protect adjacent standing timber from damage.

14. Maintenance of skid roads during periods of use is usually confined to keeping the surface water drained off.

15. Where skid roads cross streams or intermittent water courses, the stream beds should be cleaned of fill material and slash and be restored to their natural shape and grade provided the action taken does not cause greater likelihood of sedimentation and erosion.

16. Temporary closeout of skid trails should be considered if the skid trail becomes inactive for periods longer than seven days, or if a storm event is anticipated.

Log Landings

Log landings are the areas where logs are concentrated, processed, sorted and loaded prior to shipping. Care should be taken to properly locate landings to minimize the chances of erosion or sedimentation. Like skid trails, landings are subject to severe compaction. Runoff from these sites must be addressed in the pre-harvest plan and on the ground both during and after the operation is completed. Soil compaction at landing sites may require extra effort to establish an adequate vegetative cover following harvest.

Properly located and constructed log landing sites are essential for profitable and environmentally friendly timber harvesting operations. Log landings that have been properly re-vegetated at the conclusion of a harvest can provide an excellent food source for wildlife.

Specifications

1. Locate sites for log landings in advance of road construction. These sites should be located in areas that will help minimize skid trail and haul road distances.

2. Where possible, log landings should be constructed on well-drained, gently sloping sites of no more than 5%. On areas greater than 5%, additional soil protection measures may be necessary.

3. Haul roads and skid trails that terminate at the landing area should be properly drained to prevent run-off water from entering the landing. (See sections on Haul Roads and Skid Trails.)

4. Log landings should be located at least 50 feet from the SMZ. If closer placement is necessary, additional BMP measures should be considered.

5. A diversion ditch around the uphill side of landings can intercept the flow of water and direct it away from the landing.

6. Prevent stormwater runoff from landings from entering stream channels.

7. In areas where run-off water from the landing may reach a stream channel, install a silt fence, staked in straw bales and/or brush and debris barriers to filter sediment. (See Appendix A.)

8. Construct log landing no larger than is necessary to handle loading and merchandizing activities.

9. Do not drain engine fluids onto the ground when servicing equipment. Maintain equipment to control leakage of hydraulic fluids, antifreeze and similar substances. Provide proper storage and removal for fuel and other used oils. A secondary containment structure–e.g., earthen berms or straw bales–should be placed around stationary fuel tanks.

10. Keep site clean and free of trash. Do not leave trash at the site following harvest completion.

11. Disturbed areas should be reshaped to provide adequate surface drainage. Revegetate landings following completion of harvesting operations using appropriate methods and materials. (See Appendix D.)

Equipment Maintenance and Litter

- Perform all maintenance away from riparian areas.
- Capture all coolants, oils, fuels, etc. and dispose of waste properly.
- Repair equipment leaks immediately.
- Properly dispose of all trash associated with harvesting. Do not burn or bury.
- Consider the use of biodegradable fluids such as modified vegetable oil as hydraulic fluid.

Harvest Closure

The “close-down” of the timber harvest operation is one of the most important considerations to the protection of water quality. The installation of the appropriate BMPs at this time will minimize erosion and stream sedimentation after harvesting is completed. If the harvest has been effectively planned, the requirements for “close-down” will be minimal. The necessary BMPs should be installed on the site as various portions of the site have had harvesting completed. These include: regrading of ruts to prevent channelized water flow; installation of water bars on abandoned roads and trails used for the harvest; revegetation of landings, roads and bare soil areas with greater than 5% slope; removal of any temporary stream crossing structures; and the opening of any ditches or water turnouts.

The type of future access should be a consideration in the degree of closure that is desired. Is the road system going to be used for continuous or periodic aaccess? Will haul roads and skid trails be abandoned until the next rotation of timber is ready to harvest? These are the type of decisions that need to be made in the harvest planning phase of the operation, as they will influence the design characteristics of the various roads and trails and reduce maintenance costs associated with retention of an access road.

Upon completion of the harvest operation:

1. All road surfaces should be crowned, outsloped, insloped, or water-barred. Remove berms from the outside edge of the road or trail where water can be channeled. *This may not apply if the area is under a mining permit, or the timber sale contract specifies.*

2. Abandoned roads should be left in a condition that provides adequate drainage without further maintenance. These roads should be closed to traffic, scarified if required, and reseeded. The drainage system of closed roads needs careful thought and attention– water still runs on closed roads.

3. Do not allow closed roads to become stream channels. Outslope closed roads where possible, or divert channelized flow off the road surface.

4. Temporary bridges, abutments, culvert pipes or other crossing structures should be removed prior to road closure.

5. If the decision is to remove bridges and "pull" all culverts, it is also necessary to restore all drainage features to their natural condition. This includes reseeding road surfaces and all cut and fill slopes.

6. Cut and fill slopes should be reshaped to a stable gradient.

Traffic control on forest roads can be an effective way to reduce road maintenance costs and provide protection of other forest resources. Traffic control may include full road closure, temporary or seasonal closure, or require restrictions of light use only.

Any degree of control requires inspection for maintenance needs.

The unauthorized use of traffic-controlled roads is a problem for forest landowners. Damage to road surfaces can occur as easily by a pickup truck as by a logging truck. Any access that is granted voluntarily by the forest landowner or the timber operator must be done in a manner that does not compromise the stabilization effort.

In many cases, physically blocking the access to roads may be necessary. Gates are used because they can provide temporary closure along with quick access if needed. Alternatives to gates include large berms or trenches, logs, stumps or boulders. To prevent removal by vandals, gates and other barriers need to be well anchored. For safety reasons, it is advisable to provide good visibility and signage for road closure, and adequate space for turn-around.

NOTES